IN THE DRAWINGS

Applicant respectfully requests approval of the following drawing change. Specifically, Figure 8 has been amended to include reference numerals 716, 718 and 802. Applicant submits herewith a replacement drawing sheet incorporating the change to Figure 8. Also submitted herewith is an annotated Figure 8 reflecting the requested change in red ink. No new matter has been added.

REMARKS

Claims 1-38 are pending in this application. Claims 1-38 are rejected. No new matter has been added. It is respectfully submitted that the pending claims define allowable subject matter.

The drawings have been objected to as failing to comply with 37 C.F.R. §1.84(p)(5) because Figure 8 does not include elements 716, 718 and 802 referenced in the specification at paragraph 0044. Applicant has submitted herewith an Annotated Sheet and Replacement Sheet for approval wherein the reference numerals for elements 716, 718 and 802 have been added to Figure 8. Accordingly, Applicant submits that the drawing objection has been overcome and should be withdrawn.

Claims 1, 16 and 25 have been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. describes a system for three-dimensional ultrasound imaging that includes a master controller to smooth the speckle contained in pixel data filtering using a convolution filter having a nine-point kernel (abstract). The master controller includes means to perform ray-casting. The means includes a three-dimensional data memory means 70 for storing slice data as received at a data input 70a from a cine memory 24. The data associated with each object voxel is stored at the address of that voxel, responsive to voxel address input information received at a voxel address input 70b from a CPU 74. Once the data memory means is filled (corresponding to the transfer of all required data from object volume 52 to data volume 54), the object volume portion of interest is selected and data establishing a starting corner and extent in the X, Y and Z directions of the selected portion is sent from the CPU 74 to an input 72a of an address generator means 72. The means 72 then sequentially provides, at an address output 72b, the X,Y,Z addresses of each voxel within the object volume selected. Output 72b is connected to an output-data-address input 70c of data memory means 70, causing the stored intensity data for that one voxel then addressed to be output from data memory means output 70d. The sequence of voxel X,Y,Z addresses is also provided to a first input 76a of a rotational parameter calculation means 76, which receives angle information via CPU 74 as the calculated matrix element M1-M6 values, to provide at

an output 76c the address X',Y' of the image plane pixel corresponding to that object X,Y,Z pixel when viewed at a selected viewing angle. The viewing angle information is entered into the system and processed by the CPU 74 (column 8, line 52 to column 9, line 12).

The results are entered into inputs 78b and 78c of a viewing matrix means 78, to provide matrix elements M1-M6 at its output 78a and then to rotational parameter calculation means 76. The image plane pixel address X',Y' appears at an address input 80a of a frame buffer acting as an image plane memory means 80. Simultaneously, the intensity data, projected from the data volume to the projection plane, appears at the image plane memory means new data input 80b, from three-dimensional data memory means output 70d. This data also appears at the new data input 82a of a data comparator means 82. Intensity data previously saved in the image plane memory means 80 for that address, at input 80a, appears at an old data output 80c, and then at an old data input 82b of the comparator means. The old and new data at inputs 82b/82a, respectively, are compared in means 82 and an output 82c thereof is enabled to a selected logic condition (e.g., a high logic level) if the new data at input 82a has greater amplitude than the old data at input 82b. Output 82c is connected to a substitute-control data input 80d of the image plane memory means, to cause the data stored at the address controlled by input 80a to be changed to accept the new data at input 80b, if the substitute-data control input 80d is at the selected logic level. Thus, the stored data is initially reset, as by a signal through a data/control port 80e (from the CPU 74), and the data of greatest value is stored for each image plane pixel location X',Y' responsive to a comparison indicating that the new data exceeds the value of the previously stored old data. After all of the selected addresses are sequentially scanned by address generator 72, the data stored in image plane memory means 80 is scaled in the CPU 74, and the scaled image plane data can be withdrawn from memory means 80 for display, permanent storage or similar purposes (column 9, lines 12-45). Further, prior to display, the pixels in the region of interest from each slice or frame stored in the cine memory 24 may be convolution filtered by the CPU 42 and the stored in the memory 44 (column 9, lines 61-64).

Hossack et al. describes an ultrasonic system for three-dimensional imaging using opacity modulation. The opacity level associated with each datum in a 3D volume data set is controlled as a function of at least one Doppler parameter, such as variance. Areas of high variance are assigned a higher level of opacity than areas of low variance. For a Doppler velocity image, velocities associated with high variance are displayed more opaquely than

velocities associated with low variance, thereby emphasizing the more opaque regions. The more transparent velocities (i.e., those associated with low variance) still contribute to the image and are displayed. Other Doppler parameters may be used for the image, such as energy, tissue motion or variance. Furthermore, other Doppler parameters may be used to control the opacity, such as velocity, energy or tissue motion (abstract). Further, volume rendering may include alpha blending, such as depth cueing. For depth cueing, a weighting is applied to each 3D data sample (i.e., each color value and associated opacity or Doppler parameters prior to summation). The weighting values are selected to emphasize near objects. The intensity level associated with each sample may be set as a function of depth, and the opacity may be separately controlled (column 4, line 61 to column 5, line 4).

Claim 1 recites a graphics processing circuitry for a medical ultrasound system comprising "a graphics memory coupled to the graphics processing unit, the graphics memory comprising: an image data block storing image data entries for at least one ultrasound beam, a vertex data block storing vertex entries that define rendering shapes." The combination of Hatfield et al. and Hossack et al. fails to describe of suggest a graphics processing circuitry as recited in claim 1.

In the system of Hatfield et al. ray-casting is performed on an object volume of interest by selecting data establishing a starting corner in a stored and addressed voxel memory and data defining the extent of the region of interest in the X, Y and Z directions. Comparison of the selected data to previously stored data (which may be at a selected viewing angle) is then performed and data of the greatest value is stored for each image plane pixel location. Hatfield et al. is simply acquiring stored addressed data and filtering that data for display. However, in contrast to the circuitry recited in claim 1, no vertex entries defining *rendering shapes* are provided. Although, the system of Hatfield et al. stores the location for volume pixel data corresponding to an object volume, the stored data simply does not define rendering shapes. The address locations are simply used to identify a selected portion of interest for the object volume. Hossack et al. fails to make up for the deficiencies in the Hatfield et al. reference. Accordingly, the combination of Hatfield et al. and Hossack et al. fails to describe or suggest circuitry as recited in claim 1.

Claim 16 recites a medical ultrasound imaging system comprising graphics processing circuitry comprising "a graphics processing unit" and "a graphics memory coupled to the

graphics processing unit, where the signal processor stores image data entries for at least one ultrasound beam in a data block in the graphics memory, stores vertex entries that define blending shapes in a vertex data block in the graphics memory, and initiates rendering of the volume according to a plurality of rendering planes." The combination of Hatfield et al. and Hossack et al. fails to describe of suggest an ultrasound imaging system as recited in claim 16.

As discussed in more detail with respect to claim 1 the combination of the systems of Hatfield et al. and Hossack et al. simply does not include any entries that define any shapes, and in particular, blending shapes. The combination simply describes using addresses to identify a region of interest. Accordingly, the combination of Hatfield et al. and Hossack et al. fails to describe or suggest a system as recited in claim 16.

Claim 25, as amended, recites a method for rendering a volume in a medical ultrasound imaging system comprising "transferring vertex entries for the image components into a vertex data block, the vertex entries defining rendering shapes." The combination of Hatfield et al. and Hossack et al. fails to describe of suggest a method as recited in claim 25.

As discussed in more detail with respect to claim 1 the combination of the systems of Hatfield et al. and Hossack et al. simply does not include any vertex entries that define any rendering shapes. The combination simply describes using addresses to identify a region of interest. Accordingly, the combination of Hatfield et al. and Hossack et al. fails to describe or suggest a method as recited in claim 25.

Claims 2-8, 17-21 and 27-34 have been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244) and further in view of Baldwin et al. (U.S. Patent 4,827,413). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. and Hossack et al. are discussed above. Even from a cursory reading of Baldwin et al., this reference fails to make up for the deficiencies in the Hatfield et al. and Hossack et al. references. Accordingly, when the recitations of claims 2-8, 17-21 and 27-34 are considered in combination with the recitations of claims 1, 16 and 25, respectively, Applicant submits that dependent claims 2-8, 17-21 and 27-34 are likewise patentable over

the combination of Hatfield et al. in view of Hossack et al. and Baldwin et al. for at least the same reasons set forth above.

Claims 9, 10, 22, 23 and 35 have been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244) and Baldwin et al. (U.S. Patent 4,827,413) and further in view of Drebin et al. (U.S. Patent 4,835,712). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. and Hossack et al. are discussed above. Even from a cursory reading of Baldwin et al. and Drebin et al, these references fail to make up for the deficiencies in the Hatfield et al. and Hossack et al. references. Accordingly, when the recitations of claims 9 and 10 are considered in combination with the recitations of claims 1, when the recitations of claims 22 and 23 are considered in combination with the recitations of claim 16 and when the recitations of claim 35 are considered in combination with the recitations of claim 25, Applicant submits that dependent claims 9, 10, 22, 23 and 35 are likewise patentable over the combination of Hatfield et al. in view of Hossack et al., Baldwin et al. and Drebin et al. for at least the same reasons set forth above.

Claims 11, 12, 15, 24 and 36-38 have been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244) and Baldwin et al. (U.S. Patent 4,827,413) and further in view of Vining (U.S. Patent 6,083,162). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. and Hossack et al. are discussed above. Even from a cursory reading of Baldwin et al. and Vining, these references fail to make up for the deficiencies in the Hatfield et al. and Hossack et al. references. Accordingly, when the recitations of claims 11, 12 and 15 are considered in combination with the recitations of claims 1, when the recitations of claim 24 is considered in combination with the recitations of claim 16 and when the recitations of claim 36-38 are considered in combination with the recitations of claim 25, Applicant submits that dependent claims 11, 12, 15, 24 and 36-38 are likewise patentable over the combination of Hatfield et al. in view of Hossack et al., Baldwin et al. and Vining for at least the same reasons set forth above.

Claims 13 and 14 have been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244)

and further in view of Karron et al. (U.S. Patent 5,898,793). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. and Hossack et al. are discussed above. Even from a cursory reading of Karron et al., this reference fails to make up for the deficiencies in the Hatfield et al. and Hossack et al. references. Accordingly, when the recitations of claims 13 and 14 are considered in combination with the recitations of claims 1, Applicant submits that dependent claims 13 and 14 are likewise patentable over the combination of Hatfield et al. in view of Hossack et al. and Karron et al. for at least the same reasons set forth above.

Claim 26 has been rejected under 35 U.S.C. § 103(a) as being unpatenable over Hatfield et al. (U.S. Patent 5,779,641) in view of Hossack et al. (U.S. Patent 6,116,244) and further in view of Ramanujam (U.S. Patent 5,570,460). Applicant respectfully traverses the 35 U.S.C. § 103(a) rejection.

Hatfield et al. and Hossack et al. are discussed above. Even from a cursory reading of Ramanujam, this reference fails to make up for the deficiencies in the Hatfield et al. and Hossack et al. references. Accordingly, when the recitations of claim 26 are considered in combination with the recitations of claims 25, Applicant submits that dependent claim 26 is likewise patentable over the combination of Hatfield et al. in view of Hossack et al. and Ramanujam for at least the same reasons set forth above.

For at least the reasons set forth above, Applicant respectfully requests that the 35 U.S.C. § 103 rejection of claims 1-38 be withdrawn.

In view of the foregoing amendments and remarks, it is respectfully submitted that the prior art fails to teach or suggest the claimed invention and all of the pending claims in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited. Should anything remain in order to place the present application in condition for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Respectfully Submitted,

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Annotated Sheet

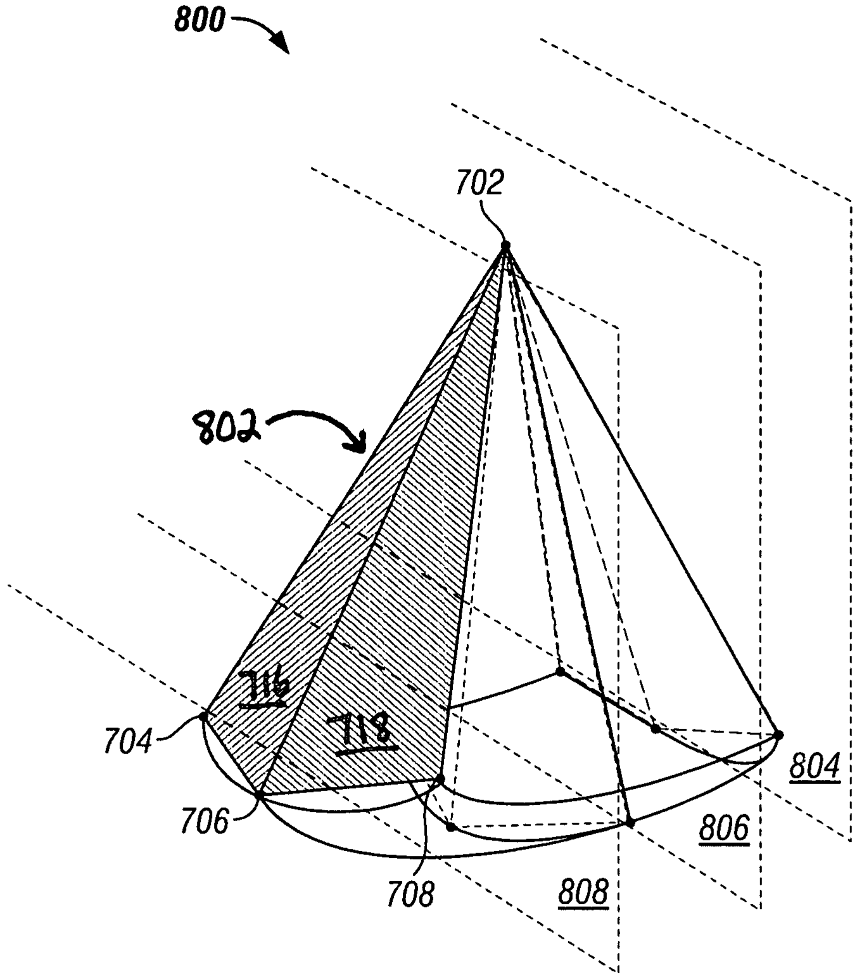

FIG. 8

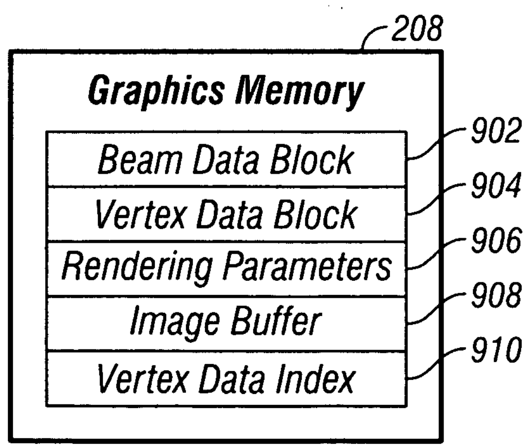

FIG. 9